Import Libraries

In [ ]:
```
import pandas as pd
import numpy as np
import plotly.express as px
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

import warnings
warnings.filterwarnings("ignore")
```

Import the dataset

In [ ]:
```
df = pd.read_csv('/content/Supermart Grocery Sales - Retail Analytics Dataset.
```

In [ ]:
```
df.head()
```

Out[ ]:

	Order ID	Customer Name	Category	Sub Category	City	Order Date	Region	Sales
0	OD1	Harish	Oil & Masala	Masalas	Vellore	11-08-2017	North	1254
1	OD2	Sudha	Beverages	Health Drinks	Krishnagiri	11-08-2017	South	749
2	OD3	Hussain	Food Grains	Atta & Flour	Perambalur	06-12-2017	West	2360
3	OD4	Jackson	Fruits & Veggies	Fresh Vegetables	Dharmapuri	10-11-2016	South	896
4	OD5	Ridhesh	Food Grains	Organic Staples	Ooty	10-11-2016	South	2355

Understand the dataset

In [ ]:
```
print('Number of rows:', df.shape[0])
print('Number of columns:', df.shape[1])
```

```
Number of rows: 9994
Number of columns: 11
```

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 11 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Order ID       9994 non-null   object 
 1   Customer Name  9994 non-null   object 
 2   Category       9994 non-null   object 
 3   Sub Category   9994 non-null   object 
 4   City           9994 non-null   object 
 5   Order Date     9994 non-null   object 
 6   Region         9994 non-null   object 
 7   Sales          9994 non-null   int64  
 8   Discount       9994 non-null   float64
 9   Profit         9994 non-null   float64
 10  State          9994 non-null   object 
dtypes: float64(2), int64(1), object(8)
memory usage: 859.0+ KB
```

In [ ]:
```python
print(df.isnull().sum())
```

```
Order ID         0
Customer Name    0
Category         0
Sub Category     0
City             0
Order Date       0
Region           0
Sales            0
Discount         0
Profit           0
State            0
dtype: int64
```

In [ ]:
```python
print(df.duplicated().sum())
```

```
0
```

In [ ]:
```python
# Function to convert mixed date formats to 'dd-mm-yy'
def convert_date_format(date):
    try:
        return pd.to_datetime(date).strftime('%d-%m-%y')
    except Exception as e:
        print(f"Error converting date {date}: {e}")
        return None

# Apply the function to the 'Order Date' column
df['Order Date'] = df['Order Date'].apply(convert_date_format)

#Extract month from the order date
# Convert 'Order Date' back to datetime objects with the correct format before
df['Order Date'] = pd.to_datetime(df['Order Date'], format='%d-%m-%y')
df['month_no'] = df['Order Date'].dt.month
df['Month'] = df['Order Date'].dt.strftime('%B')
```

```python
df['year'] = df['Order Date'].dt.year
df.head(30)
```

Out[ ]:

	Order ID	Customer Name	Category	Sub Category	City	Order Date	Region
0	OD1	Harish	Oil & Masala	Masalas	Vellore	2017-11-08	North
1	OD2	Sudha	Beverages	Health Drinks	Krishnagiri	2017-11-08	South
2	OD3	Hussain	Food Grains	Atta & Flour	Perambalur	2017-06-12	West
3	OD4	Jackson	Fruits & Veggies	Fresh Vegetables	Dharmapuri	2016-10-11	South
4	OD5	Ridhesh	Food Grains	Organic Staples	Ooty	2016-10-11	South
5	OD6	Adavan	Food Grains	Organic Staples	Dharmapuri	2015-06-09	West
6	OD7	Jonas	Fruits & Veggies	Fresh Vegetables	Trichy	2015-06-09	West
7	OD8	Hafiz	Fruits & Veggies	Fresh Fruits	Ramanadhapuram	2015-06-09	West
8	OD9	Hafiz	Bakery	Biscuits	Tirunelveli	2015-06-09	West
9	OD10	Krithika	Bakery	Cakes	Chennai	2015-06-09	West
10	OD11	Ganesh	Snacks	Chocolates	Karur	2015-06-09	West
11	OD12	Yadav	Eggs, Meat & Fish	Eggs	Namakkal	2015-06-09	West
12	OD13	Sharon	Snacks	Cookies	Dindigul	2018-04-15	South
13	OD14	Peer	Fruits & Veggies	Fresh Vegetables	Kanyakumari	2017-12-05	West
14	OD15	Sundar	Eggs, Meat & Fish	Chicken	Kanyakumari	2016-11-22	Central
15	OD16	Ramesh	Oil & Masala	Edible Oil & Ghee	Krishnagiri	2016-11-22	Central
16	OD17	Alan	Bakery	Cakes	Dharmapuri	2015-11-11	Central
17	OD18	Arutra	Beverages	Health Drinks	Bodi	2015-05-13	West
18	OD19	Haseena	Eggs, Meat &	Mutton	Tenkasi	2015-08-27	West

	Order ID	Customer Name	Category	Sub Category	City	Order Date	Region
			Fish				
19	OD20	Verma	Beverages	Soft Drinks	Kanyakumari	2015-08-27	West
20	OD21	Hafiz	Beverages	Health Drinks	Vellore	2015-08-27	West
21	OD22	Alan	Food Grains	Dals & Pulses	Karur	2017-12-09	Central
22	OD23	Haseena	Beverages	Soft Drinks	Krishnagiri	2017-12-09	Central
23	OD24	Alan	Fruits & Veggies	Organic Vegetables	Tenkasi	2018-07-16	East
24	OD25	Sharon	Eggs, Meat & Fish	Eggs	Ooty	2016-09-25	West
25	OD26	Krithika	Snacks	Chocolates	Tirunelveli	2017-01-16	West
26	OD27	Muneer	Snacks	Cookies	Trichy	2017-01-16	West
27	OD28	Jackson	Bakery	Biscuits	Viluppuram	2016-09-17	East
28	OD29	Veronica	Beverages	Soft Drinks	Krishnagiri	2016-09-17	East
29	OD30	Shah	Oil & Masala	Masalas	Kanyakumari	2016-09-17	East

Customer Insights

In [ ]:

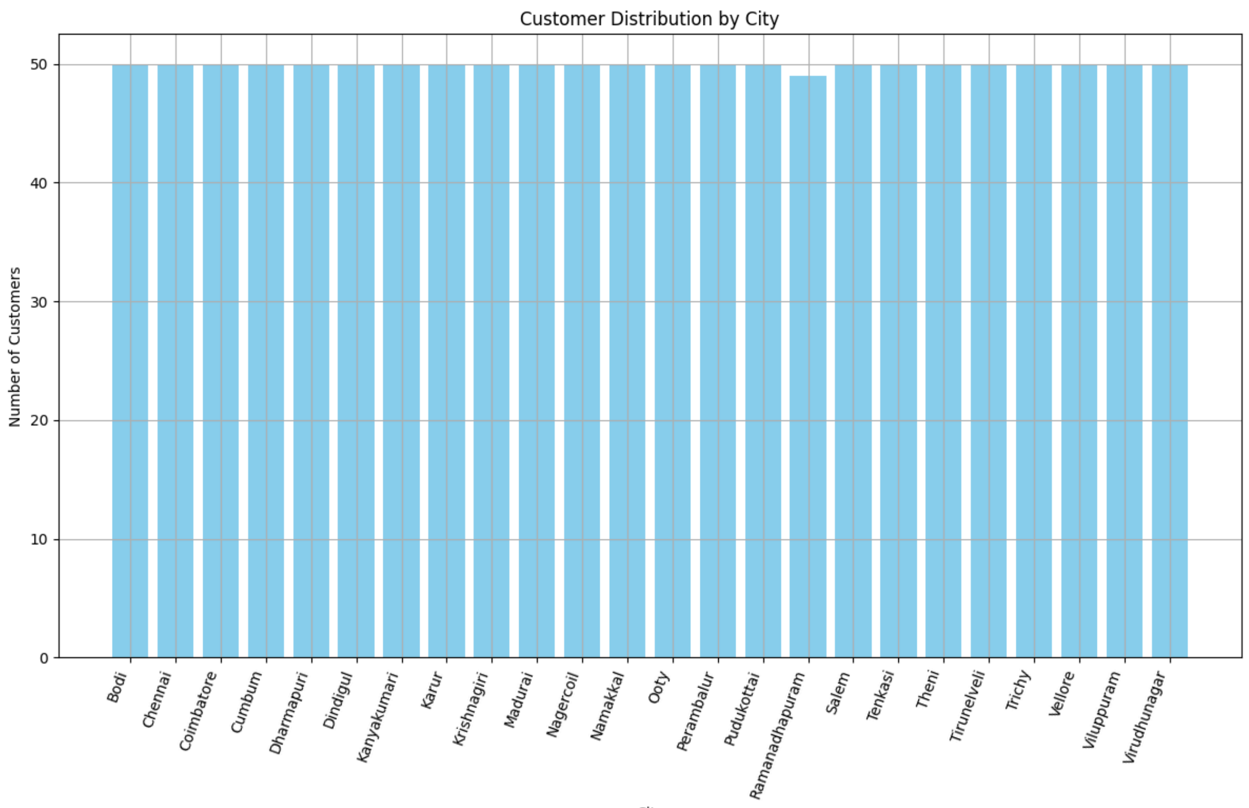
```
# Group by City and count the number of customers
customer_distribution = df.groupby('City')['Customer Name'].nunique().reset_ir
customer_distribution.columns = ['city', 'Customer_count']
customer_distribution
```

Out[ ]:

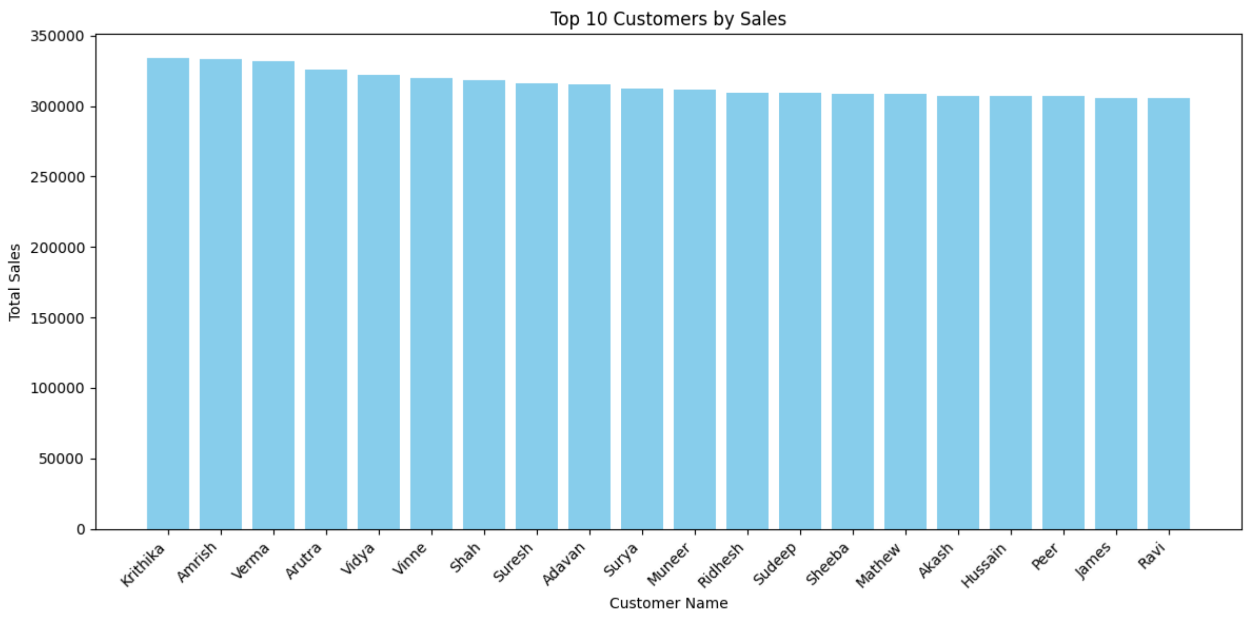
	city	Customer_count
0	Bodi	50
1	Chennai	50
2	Coimbatore	50
3	Cumbum	50
4	Dharmapuri	50
5	Dindigul	50
6	Kanyakumari	50
7	Karur	50
8	Krishnagiri	50
9	Madurai	50
10	Nagercoil	50
11	Namakkal	50
12	Ooty	50
13	Perambalur	50
14	Pudukottai	50
15	Ramanadhapuram	49
16	Salem	50
17	Tenkasi	50
18	Theni	50
19	Tirunelveli	50
20	Trichy	50
21	Vellore	50
22	Viluppuram	50
23	Virudhunagar	50

In [ ]:

```
# Plot the customer distribution
plt.figure(figsize=(12, 8))
plt.bar(customer_distribution['city'], customer_distribution['Customer_count']
plt.title('Customer Distribution by City')
plt.xlabel('City')
plt.ylabel('Number of Customers')
plt.xticks(rotation=70, ha='right')  # Rotate x-axis labels for readability
plt.grid(True)
plt.tight_layout()  # Adjust layout to prevent labels from overlapping
plt.show()
```



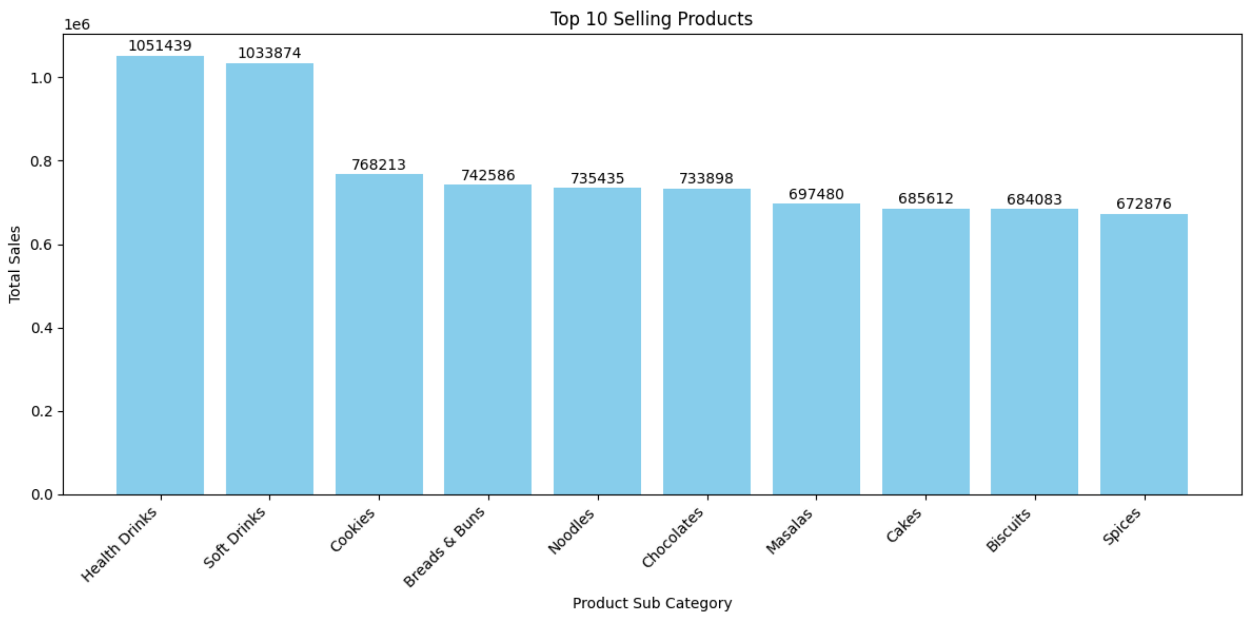
In [ ]:
```
# Group by Customer Name and calculate total sales
top_customers = df.groupby('Customer Name')['Sales'].sum().reset_index()

# Sort by sales in descending order and select the top N customers (e.g., top
top_customers = top_customers.sort_values(by=['Sales'], ascending=False).head(

# Create the bar chart
plt.figure(figsize=(12, 6))
plt.bar(top_customers['Customer Name'], top_customers['Sales'], color='skyblue
plt.title('Top 10 Customers by Sales')
plt.xlabel('Customer Name')
plt.ylabel('Total Sales')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for better readabi
plt.tight_layout()
plt.show()
```



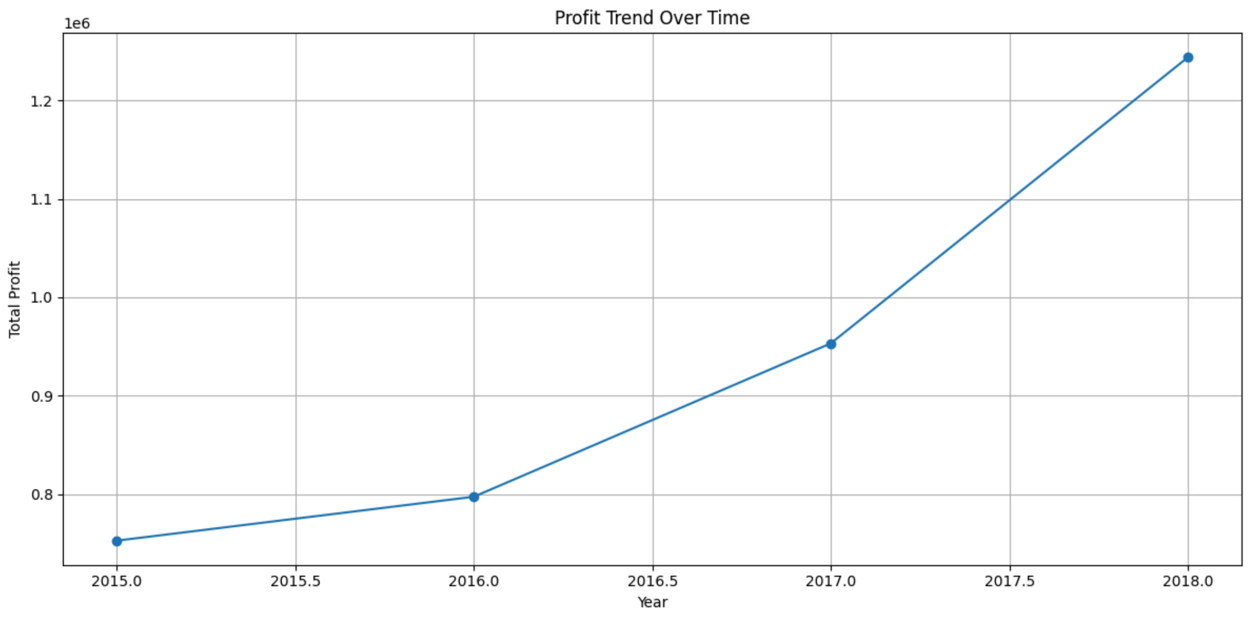
Product Analysis

Top Selling Products

In [ ]:
```
# Group by Sub-Category and calculate total sales
top_selling_products = df.groupby('Sub Category')['Sales'].sum().reset_index()

# Sort by sales in descending order and select the top N products (e.g., top 1
top_selling_products = top_selling_products.sort_values(by=['Sales'], ascendir

# Create the bar chart
plt.figure(figsize=(12, 6))
bars = plt.bar(top_selling_products['Sub Category'], top_selling_products['Sal
plt.title('Top 10 Selling Products')
plt.xlabel('Product Sub Category')
plt.ylabel('Total Sales')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for better readabi
plt.tight_layout()
# Add values on top of the bars
for bar in bars:
    yval = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, yval + 0.005*yval, round(yval, 2
plt.show()
```



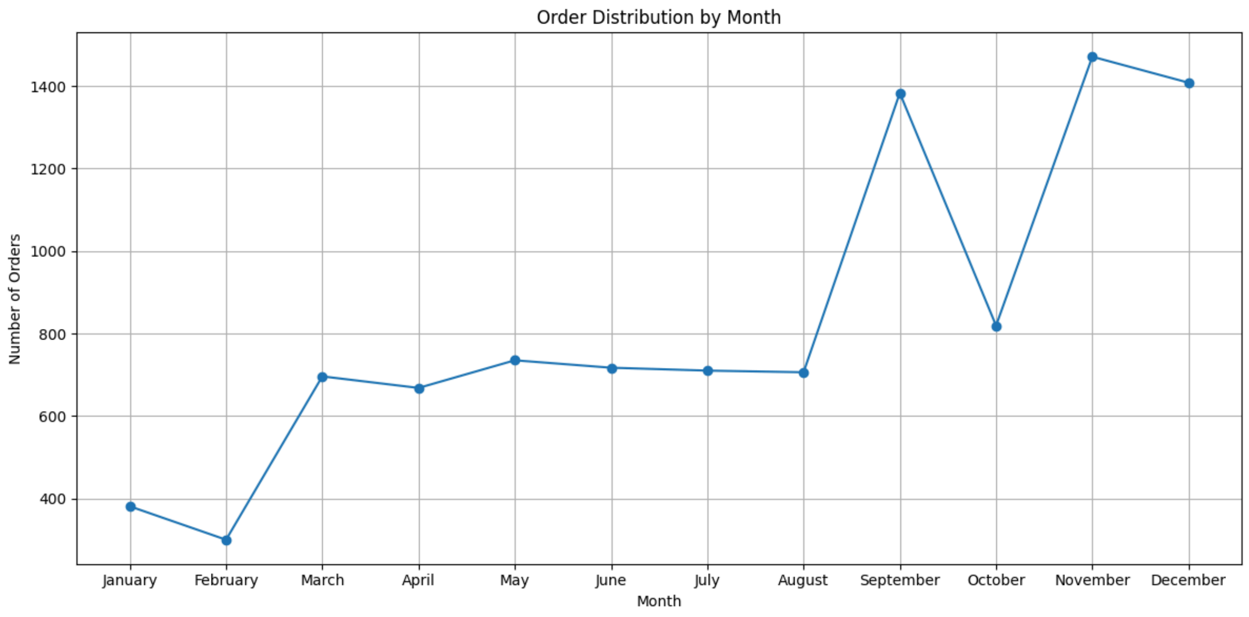
```
In [ ]: # Group by 'Order Date' and calculate total profit for each date
        profit_over_time = df.groupby('year')['Profit'].sum().reset_index()

        # Create the line chart
        plt.figure(figsize=(12, 6))
        plt.plot(profit_over_time['year'], profit_over_time['Profit'], marker='o', lir
        plt.title('Profit Trend Over Time')
        plt.xlabel('Year')
        plt.ylabel('Total Profit')
        plt.grid(True)
        plt.tight_layout()
        plt.show()
```



Order Analysis

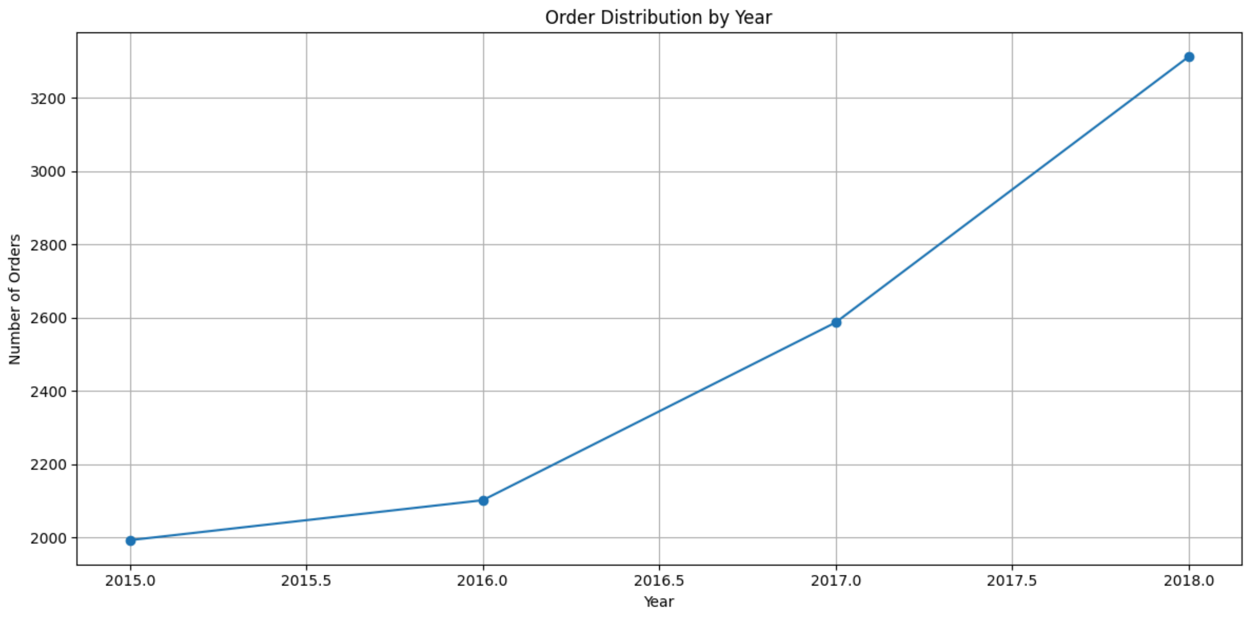
Order Distribution by Month

```
In [ ]: # Define the order of months
        month_order = ['January', 'February', 'March', 'April', 'May', 'June', 'July',

        # Group by 'Month' and count the number of orders for each date
        order_distribution = df.groupby('Month')['Order ID'].count().reindex(month_orc

        # Create the line chart
        plt.figure(figsize=(12, 6))
        plt.plot(order_distribution['Month'], order_distribution['Order ID'], marker='
        plt.title('Order Distribution by Month')
        plt.xlabel('Month')
        plt.ylabel('Number of Orders')
        plt.grid(True)
        plt.tight_layout()
        plt.show()
```



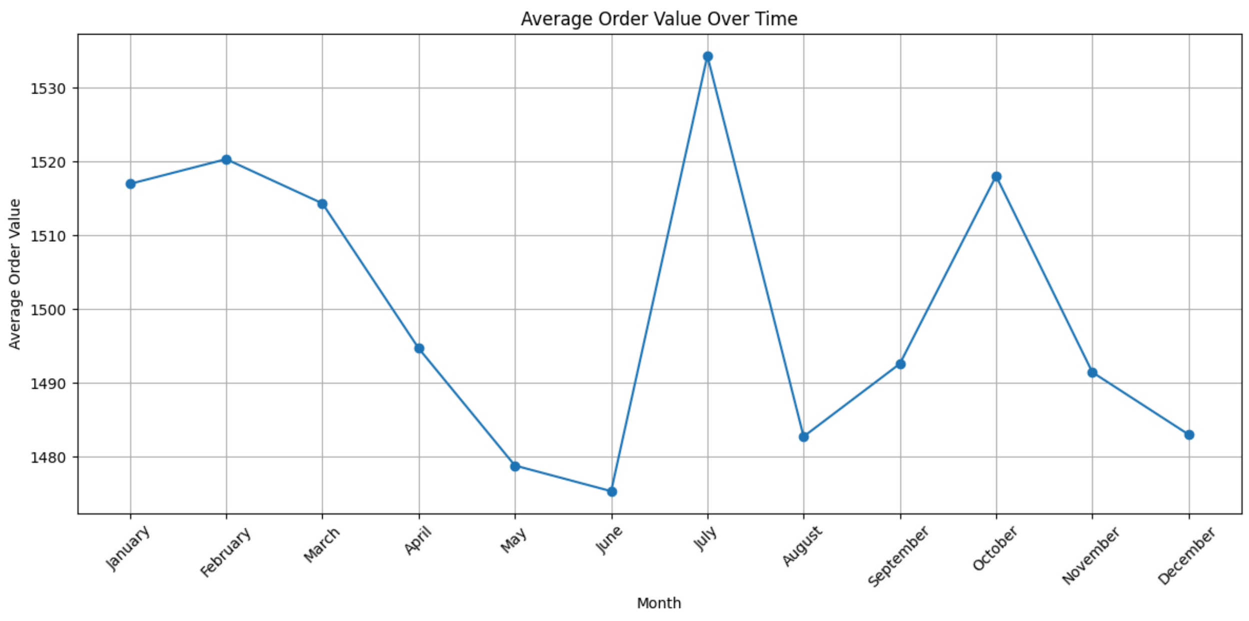
Order Distribution by Year

```
In [ ]: # Group by 'Year' and count the number of orders for each date
        order_distribution = df.groupby('year')['Order ID'].count().reset_index()

        # Create the line chart
        plt.figure(figsize=(12, 6))
        plt.plot(order_distribution['year'], order_distribution['Order ID'], marker='c
        plt.title('Order Distribution by Year')
        plt.xlabel('Year')
        plt.ylabel('Number of Orders')
        plt.grid(True)
        plt.tight_layout()
        plt.show()
```



Average Order Value over Time

```
In [ ]: # Define the order of months
month_order = ['January', 'February', 'March', 'April', 'May', 'June', 'July',

# Group by 'Month' and calculate average order value for each month
average_order_value = df.groupby('Month')['Sales'].mean().reindex(month_order)

# Create the line chart
plt.figure(figsize=(12, 6))
plt.plot(average_order_value['Month'], average_order_value['Sales'], marker='c
plt.title('Average Order Value Over Time')
plt.xlabel('Month')
plt.ylabel('Average Order Value')
plt.xticks(rotation=45)
plt.grid(True)
plt.tight_layout()
plt.show()
```

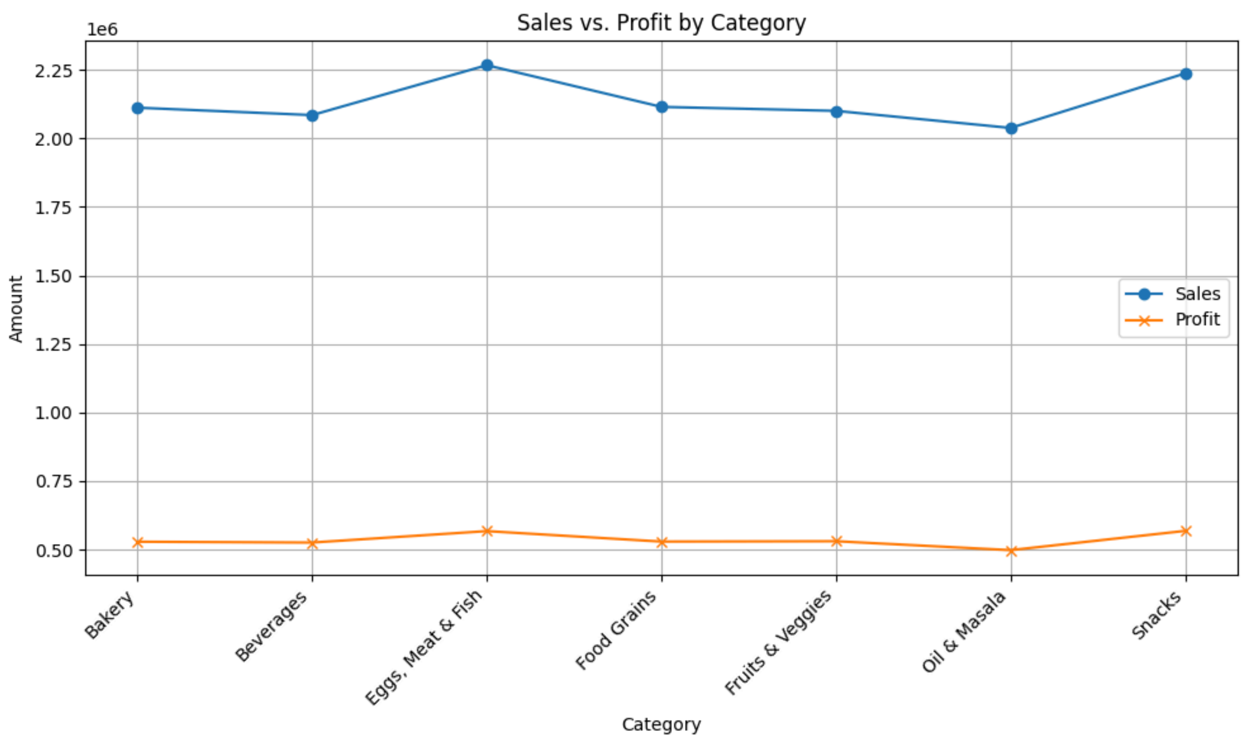


Comparative Analysis

Sales vs. Profit By Category

In [ ]:

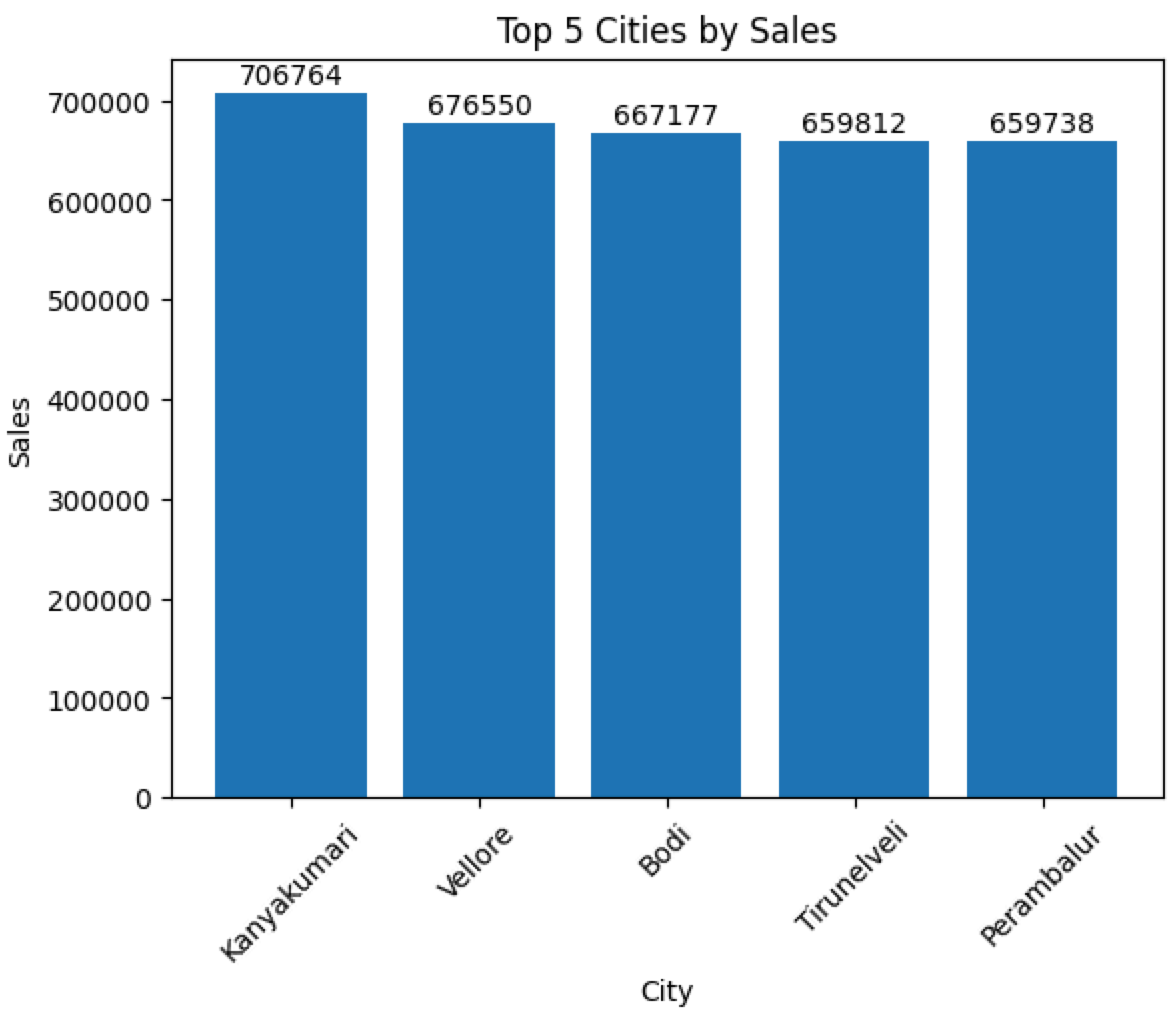
```
# Group data and calculate total sales and profit
grouped_data = df.groupby('Category')[['Sales', 'Profit']].sum().reset_index()

# Create the line plot
plt.figure(figsize=(10, 6))
plt.plot(grouped_data['Category'], grouped_data['Sales'], marker='o', label='S
plt.plot(grouped_data['Category'], grouped_data['Profit'], marker='x', label='

plt.title('Sales vs. Profit by Category')
plt.xlabel('Category')
plt.ylabel('Amount')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for better readabi
plt.grid(True)
plt.legend()
plt.tight_layout()
plt.show()
```



Sales Performance

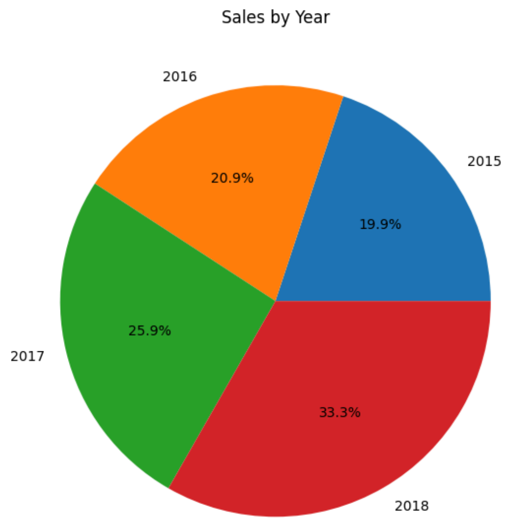
Top 5 Cities By Sales

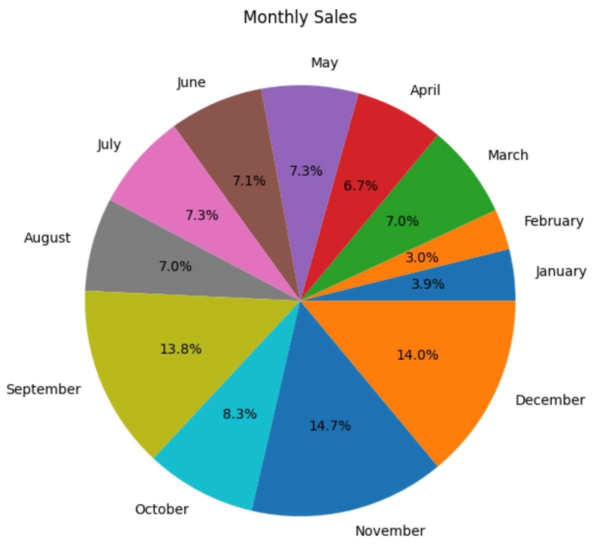
In [ ]:
```
#Extract relevant columns
city_sales = df[['City', 'Sales']]

#Calculate total sales per city
total_sales = city_sales.groupby('City').sum()
sorted_cities = total_sales.sort_values(by='Sales', ascending=False)

#Select the top 5 cities
top_cities = sorted_cities.head(5)

#Plot the bar chart
bars = plt.bar(top_cities.index, top_cities['Sales'])
plt.xlabel('City')
plt.ylabel('Sales')
plt.title('Top 5 Cities by Sales')
plt.xticks(rotation=45)

# Add values on top of the bars
for bar in bars:
    yval = bar.get_height()
    plt.text(bar.get_x() + bar.get_width()/2, yval + 0.005*yval, round(yval, 2
plt.show()
```



Sales By Year

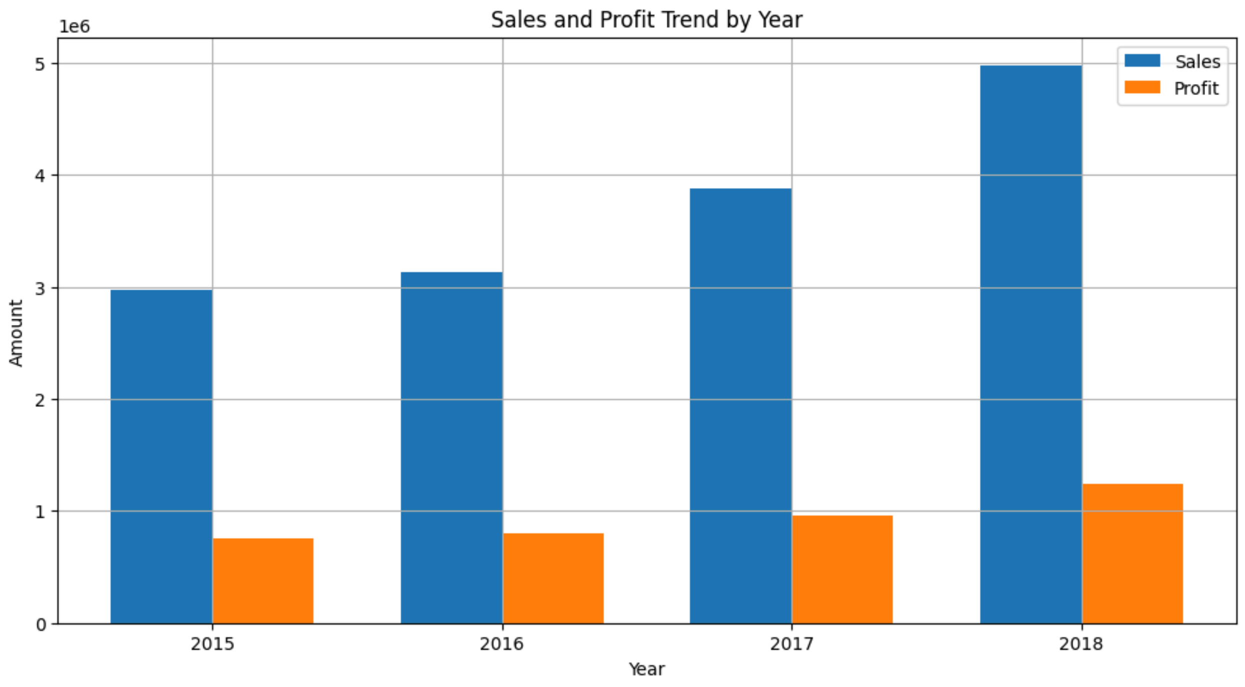
In [ ]:
```
# Create subplots
fig, axs = plt.subplots(1, 2, figsize=(14, 6))

# Assuming your DataFrame has a column named 'Order Date'
Yearly_Sales = df.groupby("year")["Sales"].sum()
axs[0].pie(Yearly_Sales, labels=Yearly_Sales.index, autopct='%1.1f%%')
axs[0].set_title('Sales by Year')

# and you want to group by month extracted from 'Order Date'
Monthly_Sales = df.groupby("Month")["Sales"].sum()
# Reorder the months to ensure correct display in the pie chart
Monthly_Sales = Monthly_Sales.reindex(['January', 'February', 'March', 'April'

axs[1].pie(Monthly_Sales, labels=Monthly_Sales.index, autopct='%1.1f%%')
axs[1].set_title('Monthly Sales')

plt.tight_layout()
plt.show()
```





Sales and Profit Trend By Year

```
In [ ]: # Group by year and sum sales and profit
yearly_data = df.groupby('year')[['Sales', 'Profit']].sum().reset_index()

# Create bar plot
fig, ax = plt.subplots(figsize=(12, 6))

width = 0.35  # Width of the bars

ax.bar(yearly_data['year'] - width/2, yearly_data['Sales'], width, label='Sale
ax.bar(yearly_data['year'] + width/2, yearly_data['Profit'], width, label='Pro

# Customize plot
ax.set_xlabel('Year')
ax.set_ylabel('Amount')
ax.set_title('Sales and Profit Trend by Year')
ax.legend()
ax.grid(True)

plt.xticks(yearly_data['year'])  # Set x-axis ticks to years

plt.show()
```



```
In [ ]: # Create scatterplot of sales and profit
        fig = px.scatter(df, x='Sales', y='Profit', title='Sales vs. Profit')
        fig.show()
```

Sales By Region

```
In [ ]: # Create boxplot of sales by region
        fig = px.box(df, x='Region', y='Sales', title='Sales by Region')
        fig.show()
```

Sales and Profit by Region

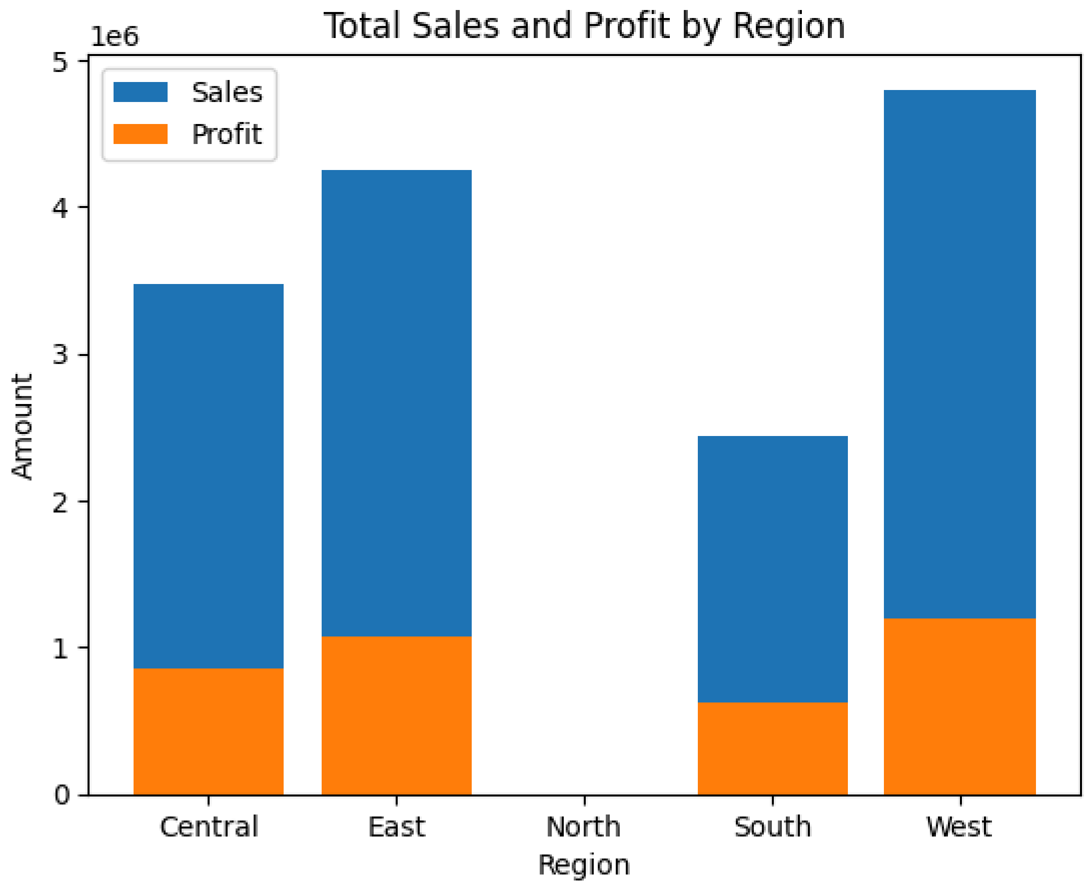
In [ ]:
```
# Calculate total sales and profit by region
sales_by_region = df.groupby('Region')['Sales'].sum().reset_index()
profit_by_region = df.groupby('Region')['Profit'].sum().reset_index()

# Merge the two dataframes
sales_profit_by_region = pd.merge(sales_by_region, profit_by_region, on='Regio

# Display the results
sales_profit_by_region.head()
```

Out[ ]:

	Region	Sales	Profit
0	Central	3468156	856806.84
1	East	4248368	1074345.58
2	North	1254	401.28
3	South	2440461	623562.89
4	West	4798743	1192004.61

In [ ]:

```
# Plot the bar chart
fig, ax = plt.subplots()
ax.bar(sales_profit_by_region['Region'], sales_profit_by_region['Sales'], labe
ax.bar(sales_profit_by_region['Region'], sales_profit_by_region['Profit'], lab
ax.set_xlabel('Region')
ax.set_ylabel('Amount')
ax.set_title('Total Sales and Profit by Region')
ax.legend()

# Show the plot
plt.show()
```



Sales and Profit by City

In [ ]:
```
# Calculate total sales and profit by city
sales_by_city = df.groupby('City')['Sales'].sum().reset_index()
profit_by_city = df.groupby('City')['Profit'].sum().reset_index()

# Merge the two dataframes
sales_profit_by_city = pd.merge(sales_by_city, profit_by_city, on='City')

# Display the results
sales_profit_by_city.head()
```

Out[ ]:

	City	Sales	Profit
0	Bodi	667177	173655.13
1	Chennai	634963	160921.33
2	Coimbatore	634748	157399.41
3	Cumbum	626047	156355.13
4	Dharmapuri	571553	141593.05

Sales by Category and Sub Category

In [ ]:
```
# Calculate total sales by category and sub-category
category_sales = df.groupby(['Category', 'Sub Category'])['Sales'].sum().reset

# Create bar chart of total sales by category
fig = px.bar(category_sales, x='Category', y='Sales', color='Sub Category', ti
fig.show()
```

```
In [ ]: # Create pie chart of total sales by sub-category
        fig = px.pie(category_sales, values='Sales', names='Sub Category', title='Tota
        fig.show()
```

Profit by Category and Sub Category

Total Profit by Category

In [ ]:
```
# Calculate total profit by category and sub-category
category_profit = df.groupby(['Category', 'Sub Category'])['Profit'].sum().res

# Create bar chart of total profit by category
fig = px.bar(category_profit, x='Category', y='Profit', color='Sub Category',
fig.show()
```

Total Profit By Sub Category

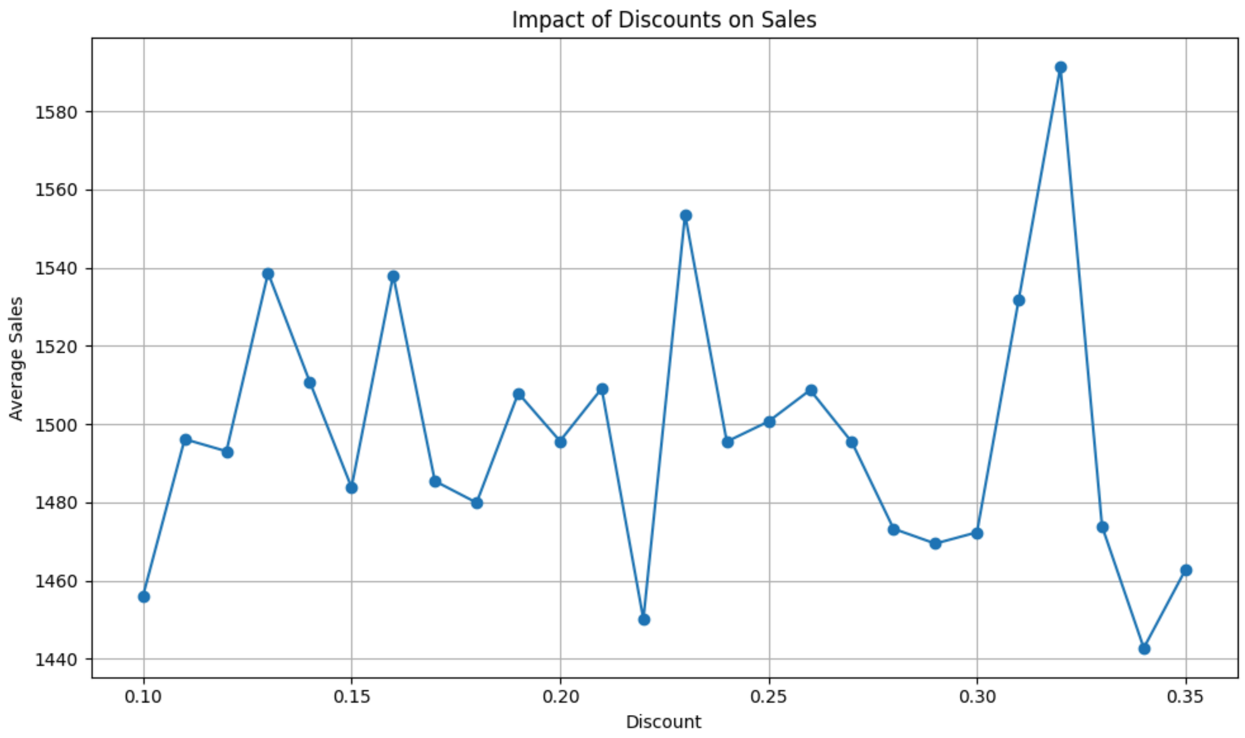
```
In [ ]: # Create pie chart of total profit by sub-category
        fig = px.pie(category_profit, values='Profit', names='Sub Category', title='To
        fig.show()
```

Discount Analysis

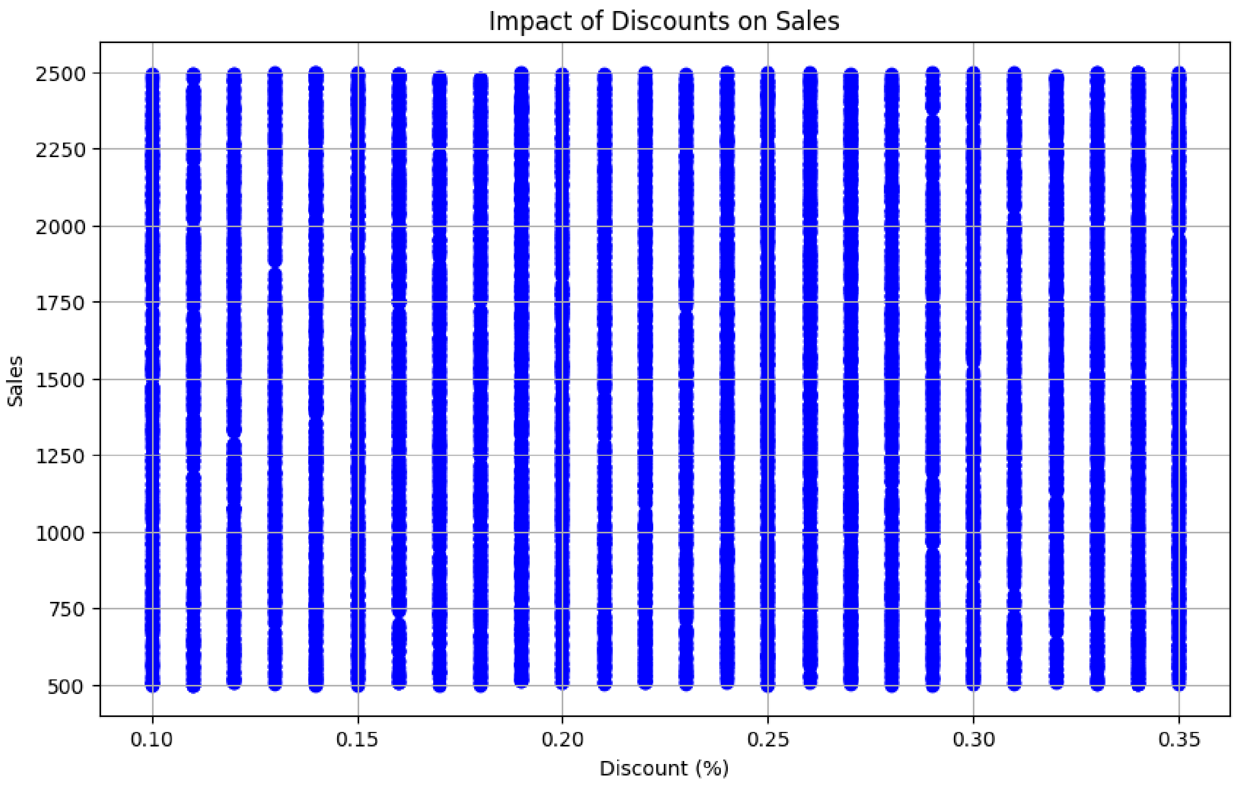
Impact of Discounts on Sales

In [ ]:

```
# Group by Discount and calculate average sales for each discount level
discount_sales = df.groupby('Discount')['Sales'].mean().reset_index()

# Create the line plot
plt.figure(figsize=(10, 6))
plt.plot(discount_sales['Discount'], discount_sales['Sales'], marker='o', line
plt.title('Impact of Discounts on Sales')
plt.xlabel('Discount')
plt.ylabel('Average Sales')
plt.grid(True)
plt.tight_layout()
plt.show()
```



```
In [ ]: # Plot scatter plot
        plt.figure(figsize=(10, 6))
        plt.scatter(df['Discount'], df['Sales'], color='blue')
        plt.title('Impact of Discounts on Sales')
        plt.xlabel('Discount (%)')
        plt.ylabel('Sales')
        plt.grid(True)
        plt.show()
```



Key Observations:

- Positive Trend: There is an upward trend in the scatter plot, indicating that higher discounts are generally associated with higher sales.
- Correlation: The positive correlation between discounts and sales suggests that as discount percentages increase, sales amounts also tend to increase.
- Distribution: The points are spread out, but the general pattern shows that higher discounts often result in higher sales values.
- **Effectiveness of Discounts: Higher discounts (30-40%) lead to significant sales increases**.

Analysis:

- Positive Correlation: The graph indicates that discounts effectively drive sales. Customers are more likely to make purchases when they perceive higher value due to discounts.
- Optimization: Retailers can use this information to optimize discount strategies, offering discounts that effectively drive sales without unnecessarily reducing profit margins.